REMARKS

Claims 1-40 are canceled in order to gain examination of claims 41-60 amended as discussed below.

Applicants have noted from the comments of the Examiner that the claims as previously presented could be more broadly interpreted than intended. Applicants further note that the claims as previously drafted were intended to cover a variety of embodiments. Applicants hereby tailor the claims to focus on a preferred aspect of the invention as explained below. No new matter is introduced by these amendments, and Applicants do not surrender their right to file continuation or divisional applications to matter not prosecuted in this RCE. Claim corrections or revisions find support in the specification as filed as follows:

New claims 41 and 50 claim the rapid prototyping processes described in paragraph [0029] of the specification.

The term "the average particle size" has been made more precise by amendment to "particle diameter" as supported by paragraph [0039].

The term "fine material" has been amended to "fine particles" for consistency.

The term "large particles" has been amended to "coarse particles" for consistency.

Paragraph [0034] describes the fine material (fine particles) as "ceramic binder, which in the ceramic form is the binder phase". The large ceramic particles are bonded by the ceramic binder "without substantially melting the coarse particles" – this being inherent in the formation of the porous ceramic mold (that is, if the coarse particles melted, the product would be a non-porous solid, porosity is maintained only if the large particles substantially do not melt).

The reference to particles adhering is supported by pargraph [0039].

Laser sintering is claimed in the original claims and described in paragraph [0041].

Support for new claims 43 and 55 can be found in paragraph [0036] of the specification.

Support for new claim 44 can be found in paragraph [0034].

New claims 46 and 52 find support in paragraph [0018].

New claim 41 is presented in order to correct a technical problem with the original claims – namely, if the coarse and fine particles were of the same material, then the fine particles would

have the if fine is same material, it can not have lower sinter temp. Just sinters first because small has less mass and heats up faster than large.

48 and 49 are previous 19 and 20.

Turning now to a brief explanation of the patentability over the prior art of the essential feature of the invention as presently claimed:

State of the art:

It is known to make molds by rapid prototyping, and to fire (sinter) a green form to produce a ceramic mold, but

(1) the mold (initially formed of organic binder and unsintered particles) usually requires sintering to gain sufficient strength for casting, but sintering may cause the mold to shrink; and

(2) the ceramic particles may have low thermal coefficient of expansion (TCE). Metal has a high TCE. Thus, when molten metal is poured into a ceramic mold, the mold only expands slightly when raised to the temperature of the molten metal, then, on cooling, the metal shrinks more than the mold shrinks, resulting in stress on the metal part and poor dimensional trueness.

Solution:

Regarding problem (1), as discussed in paragraph [0032] of the specification, the present invention takes advantage of the phenomena that, upon application of heat to a mixture of fine and large particles, the fine particles have a "higher sinterability", i.e., they melt and sinter earlier than large particles. They thus can be used to build bridges between large particles, before the large particles melt. Since the large particles do not melt, the form stability of the mold is maintained, and there is little or no sintering shrinkage.

In accordance with the invention, the fine particles are either sintered by laser sintering during rapid prototyping process (claim 41 and 42), or after a rapid prototyping process 3D-printing (claim 50).

Problem (2) is solved by matching the TCE of the particles to the TCE of the metal to be cast (TCE of the ceramic is above approximately $8.5*10^{-6}K^{-1}$).

The incorporation of fine particles in the coating of the coarse particles is particularly preferred, as this ensures good distribution of fine particles and prevents accumulation of fine particles between the coarse particles.

Prosecution History

In Amendment C Applicants argued that Langer

(a) discloses no porous ceramic. Langer is NOT porous and combination with state of the art disclosing porosity would not be reasonable;

(b) discloses no fine particles, the role of which is critical to the present invention as discussed above; and

(c) discloses no mention of expansion coefficient.

Applicants then argue (and repeat in Amendment D and E) that dimensional stability of the casting mold is achieved by adding fine particles.

In Amendment D Applicants again argued that Langer teaches only not-sintered green mold (molding sand plus heat hardened resin binder). Mold strength is not provided by sintering.

Turning now to the current rejections:

Claims Rejections – 35 USC 103

Claims 21-22, 25-27, and 30-39 have been rejected under 35 USC 103(a) as being obvious over Marcus et al. (US 5,147,587) (hereinafter "Marcus") in view of Nagai et al. (US 5,677,045) (hereinafter "Nagai").

Claims 23-24 and 40 are rejected under 35 USC 103(a) as being obvious over Marcus et al. in view of Nagai et al. and further in view of either Zoia et al. (US 6,609,043) or Smith et al. (US 6,354,362).

Claims 28-29 are rejected under 35 USC 103(a) as being obvious over Marcus et al. in view of Nagai et al. and further in view of Kington (US 4,989,667).

Applicants respectfully traverse.

Marcus is not nearer than the nearest prior art reference Langer cited in previous Office actions.

The Examiner's argument that Marcus discloses a powder comprising alumina particles coated by polymer binder and finer ammonium dihydrogen phosphate is incorrect. In fact, the Examiner appears to have mixed two different disclosed powders and invented a new component that is not disclosed. There are two kinds of pluralities of materials disclosed in Marcus (see column 8, lines 12-17): kind I are blends; kind II are coated materials. Some examples of kind II (coated materials) are disclosed in column 9, line 27-42, including aluminum silicate coated with a polymer. An example of kind I (blended materials) is disclosed in column 9, line 66 to column 10 line 25, consisting of a first component alumina and a second component ammonium dihydrogen phosphate. The Examiner has evidently mixed both kinds.

Also, Applicants cannot find any hint in Marcus why the ammonium dihydrogen phosphate particles should be finer than the alumina particles and the Examiner did not provide any support for his argumentation.

Further, there is no hint concerning any porosity and no hint concerning an expansion coefficient, especially not to a sufficient expansion coefficient. Therefore, Marcus is not nearer to the present invention than Langer.

In addition, the Examiner has tried to find any state of the art disclosing a sufficient expansion coefficient but neglected any convincing argument as to why a person skilled in the art would search for such an state of the art and combine it with Langer or Marcus.

The Examiner has admitted that Marcus fails to teach the use of resin having relatively high thermal expansion coefficient. However, the Examiner did not provide any motivation why a person skilled in the art should search for any material with high thermal expansion coefficient. The only reason why the Examiner has argued this way appears to be that the newly introduced prior art reference Nagai discloses such an resin. But this is not permitted hindsight. The Examiner did not give any reason why a person skilled in the art, starting from Marcus and trying to improve Marcus, should search for a material with a high thermal expansion coefficient.

The Examiner did not provide no hint how the person skilled in the art should find Nagai which discloses totally different subject matter concerning semiconductor printed circuits and is classified totally different from the present invention or Marcus. Further, the Examiner did not offer any reason why the person skilled in the art should combine those totally different states of the art. Even if the person skilled in the art would combine those totally different states of the art, the result would not work because the resin of Nagai may have a sufficient range of expansion coefficient but its glass transition temperature of 150-300°C is not sufficient at all. Such a resin would just evaporate when used in a casting process. Therefore, the combination of Marcus and Nagai would disappoint the person skilled in the art and therefore would lead away from the present invention

The object of the present invention is to guarantee a sufficiently good dimensional stability of the casting mold. This object is achieved by additional application of fine particles, through which the temperature required for the sintering compound of the course particles is lowered, especially shrinkage is reduced.

The object of Langer is just the same as the present invention while the object of Marcus is to provide a method of producing a part out of multiple material powder by melting one of the materials but where the final part is formed by an chemical reaction between the components and where the final part has a much higher melting point due to the chemical transformation of the materials. Therefore, the object of Marcus is totally different and Langer is a much nearer prior art reference. This is also evidenced by the fact that Langer and the present invention show the same US Patent classification while Marcus shows a totally different classification. But Langer discloses a totally different alternative solution to the present invention, as already discussed in detail in the previous responses.

Applicants have argued that Langer has already solved the problem of the present invention, but in a different way. So there is no motivation for a person skilled in the art to look for another solution. The Examiner has not commented on this argument.

Applicants have argued that a person skilled in the art would neither search for, nor find, nor use Goldsmith. The same argument applies to the newly cited reference Nagai as well.

The present invention and Langer concern the production of casting molds with rapid prototyping. In contrast, Nagai concerns semiconductor printed circuits. Accordingly the IPC and the US Cl. of Nagai are totally different. Furthermore, Nagai does not disclose any suitable material as discussed above.

In viewing of the above, it is believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of the claims as amended.

The Commissioner is hereby authorized to charge any fees which may be required at any time during the prosecution of this application without specific authorization, or credit any overpayment, to Deposit Account Number 50-0951.

Withdrawal of the rejections and early issuance of a Notice of Allowance are respectfully requested. **Should further issues remain prior to allowance, the Examiner is respectfully requested to contact the undersigned at the indicated telephone number.**

Respectfully submitted,

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